Overview of Effect of TDRS H on Current SN Users

1 Overview

1.1 General

There are currently six TDRSs. These are known as F1, and F3 – F7.

- The TDRS fleet is aging. The older of these six TDRSs have exceeded their nominal life-spans. At least three of the six TDRSs have at least a partial failure on at least one of their services.

- NASA is in the process of replenishing the TDRS fleet with three new TDRSs known as TDRS H, I, and J.

1.2 TDRS Fleet

As of the Fall of 1999, six TDRSs will be available for customer support:

- F6 at 041 and named TDE.

- F4 at 047 and named TDS.

- F1 at 049.

- F7 at 171.

- F5 at 174 and named TDW.

- F3 at 275.

TDRS H will be operational as of the Summer of 2000 in a TBD location. It will probably not become a prime TDRS (i.e., TDE at 041 or TDW at 174) until some time after that.

1.3 TDRS H,I,J Services

For forward and return services, the current TDRSs offer three types of services. The new TDRSs offer four types of services:

- Ka-band Single Access (SA) service -- (KaSA). Two SA antennas per TDRS. One KaSA forward and one KaSA return service per SA antenna.

  – New. No effect on current users. Applies only to new users.

- Ku-band SA service -- (KuSA). Two SA antennas per TDRS. One KuSA forward and KuSA one return service per SA antenna.

  – No change from current support.

NOTE

Ka-band and Ku-band services cannot be scheduled at the same time on the same antenna.

- S-band SA service -- (SSA). Two SA antennas per TDRS. One SSA forward and one SSA return service per SA antenna.

    – No change from current support.

- S-band Multiple Access (MA) service --- (SMA). One MA antenna per TDRS. One SMA forward and five SMA return services per MA antenna.

    – Replacement of the current S-band MA service capability. For TDRS H, I, J these services are referred to as SMA. For TDRS F1, and F3 – F7, these services are referred to as MA.

    – Customer spacecraft to TDRS interface for SMA is backward compatible with and is generally superior to the customer spacecraft to TDRS interface for MA.

        — Some current MA users may experience improved performance with use of SMA.

        — Some current SSA users who were unable to use MA may be able to use SMA.

    – New SMA message formats are not backward compatible with current MA message formats.

1.4 NCC 98 Implementation of SMA

NCC 98 is implemented to regard SMA services as unique. Any user who wishes to use SMA services must schedule these as unique service types. NCC 98 has no capability to translate between service types (e.g., MA to SMA).

2 Effect of TDRS H on Current MA Users

2.1 General

All current MA users will be able to continue to obtain MA support from F1, F3 – F7. TDRS H will have little operational effect until it is positioned as a prime TDRS. At that time, current MA users should begin to obtain SMA support from TDRS H.

NOTE

Use of specific TDRSs by specific customers is subject to access restrictions implemented in the NCCDS database.

2.2 Spacecraft Interface

The TDRS H MA antenna is backwards compatible with the current MA antennas. Any customer spacecraft currently obtaining S-band support by use of TDRS MA services will be able to use SMA services.

2.3 Coverage

When TDRS H becomes a prime TDRS, current MA users will have two alternatives:

- Schedule SMA support on TDRS H. User ground systems must adapt to use of SMA message formats. Although there may be minor differences between the field of view of the TDRS H, I, J MA antennas and the TDRS F1, and F3 – F7 MA antennas, this will allow for essentially the same orbital coverage as in current operations.

- Depending on whether TDRS H is positioned as TDE at 041 or TDW at 174, schedule MA support on 047 or 171. This reduces orbital coverage by several longitudinal degrees unless the user is also authorized to schedule MA support on 275.

NOTE

Use of specific TDRSs by specific customers is subject to access restrictions implemented in the NCCDS database.

2.4 Message Formats

2.4.1 General

All of the following is based on formats as shown in Revision 1 of 451-ICD-NCCDS/MOC. Although nearly all MA users actually also use SSA, the formats are considered from the perspective of an MA user who does not currently use SSA formats.

- SMA forward service formats are based on MA forward service formats.

- SMA return service formats are based on SSA return service formats.

2.4.2 Database and Scheduling

a. Formats with no new parameters, but with new parameter values for SMA service identification.

1. MA/SMA Forward Service -- (Table 7-14)

2. Normal Tracking Service -- (Table 7-20)

3. Cross-Support Tracking Service -- (Table 7-21)

4. Simulation Service -- (Table 7-22)

5. TDRS Unscheduled Time Entry -- (Table 7-24)

NOTE

> This is applicable to use of WWW interface to obtain TUT information.

6. Tracking Service Specification Code Data -- (Table A-14)

b. New formats

1. SSA/SMA Return Service -- (Table 7-18)

2. SMA Forward Service Specification Code Data -- (Table A-2)

NOTE

> This is applicable to NCCDS database and does not directly affect any user system.

3. SMA Return Service Specification Code Data -- (Table A-7)

NOTE

> This is applicable to NCCDS database and does not directly affect any user system.

2.4.3 GCMRs

a. Formats with no new parameters, but with new parameter values for SMA service identification.

1. User Reacquisition Request Message -- (Table 8-1)

2. Forward Link Sweep Request Message -- (Table 8-2)

3. Expanded User Frequency Uncertainty Request Message -- (Table 8-4)

4. MA/SMA Forward Link Reconfiguration Request Message -- (Table 8-5)

5. Doppler Compensation Inhibit Request Message -- (Table 8-11)

b. New formats

1. SSA/SMA Return Link Reconfiguration Request Message -- (Table 8-9)

2.4.4 Performance Data

a. Formats applicable to SMA with no change from MA

1. MA/SMAF Service Type Header Data Packet -- (Table 8-31)

2. MA/SMA Forward Service Data Packet -- (Table 8-32)

b. Formats with no new parameters, but with new parameter values for SMA service identification.

1. Return Channel Time Delay Measurement Message -- (Table 8-16)

2. Acquisition Failure Notification Message -- (Table 8-17)

3. Time Transfer Message -- (Table 8-18)

4. Simulation Forward Service Data Packet -- (Table 8-36)

5. Simulation Return Service Data Packet -- (Table 8-37)

c. New formats

1. SA/SMAR Service Type Header Data Packet -- (Table 8-20)

2. SSA/SMA DG1 Return Service Data Packet -- (Table 8-23)

3. SSA/SMA Return Service Data Quality Monitoring Packet -- (Table 8-26)

<div align="center">NOTE</div>

It is assumed that an MA user would always schedule SMAR as DG1, therefore the SSA/SMA DG2 Return Service Data Packet (Table 8-24) is omitted.

3 Effect of TDRS H on Current SSA Users

3.1 General

All current SSA users will be able to continue to obtain SSA support from all TDRSs including TDRS H. However, the TDRS H SMA capability is a significant improvement over the current MA capability. Some current SSA users will be able to obtain satisfactory S-band support by use of the TDRS H SMA services. For these users, SMA will provide two significant benefits:

- Greater scheduling success due to increase in number of available links.

- Lower per minute costs for use of TDRS services.

<div align="center">NOTE</div>

Use of specific TDRSs by specific customers is subject to access restrictions implemented in the NCCDS database.

<div align="center">NOTE</div>

Actual SMA reimbursable service rates are TBD.

3.2 Criteria for Use of SMA by Current SSA Users

Several constraints apply to use of SMA that do not apply to use of SSA. In order to successfully use SMA, an SSA user must be operate within the following constraints:

a. Service configuration. The user must be a normal user. The Shuttle has unique S-band requirements, and cannot use SMA.

b. S-band is used independently of Ku-band. If the user routinely schedules Ku-band services that equal or exceed the duration of concurrently scheduled S-band services, both the Ku-band and S-band services should be scheduled on the same SA antenna.

<div align="center">5</div>

Since the use of SMA would require the allocation of additional resources, there would be no advantage to the use of SMA.

c.   Left Circular Polarization. SMA cannot be configured to use right circular polarization.

d.   Fixed Frequencies. SMA uses fixed frequencies within the S-band. The user spacecraft must be able to use these specific frequencies.

    1.   SMA forward is fixed at 2106.4 MHz.

    2.   SMA return is fixed at 2287.5 MHz.

e.   Data rates.

    1.   The maximum SMA forward data rate is 300 KBPS.

    2.   The maximum SMA single channel return data rate depends on the values of several parameters including data group (i.e., DG1 or DG2), DG1 mode, and data channel configuration. For DG2 and for DG1 mode 3 Q-channel, the maximum data rates are one-half of the maximum SSAR data rates for the same configuration. For other configurations, the maximum SMAR data rates are the same the maximum SSAR data rates.

f.   Command Channel PN Modulation. The user must not require this parameter to be set to NO.

g.   Visibility. The field of view of the SMA antenna is limited to spacecraft at altitudes below approximately 1300 km. Although this is sufficient to cover nearly all foreseeable orbiting customer spacecraft, it does not cover certain users (e.g., expendable launch vehicles) that can be covered by the SA antennas.

h.   Power. For forward services, the SMA antenna provides a lower maximum power to the customer spacecraft than does the SA antenna. For return services, the SMA antenna requires a higher minimum power from the customer spacecraft than does the SA antenna. For some users, this may result in the usable SMA view being smaller than the usable SA view.

    1.   The maximum SMA forward EIRP is 42 dBw. There is no high power mode.

    2.   Return. To achieve equivalent performance at the same data rate, SMA return requires 4 dB greater P_{rec} than does SSA return.

<div align="center">NOTE</div>

P_{rec} is the user spacecraft signal power received at a TDRS antenna input. P_{rec} is a function of the user's EIRP.

3.3 Message Formats

3.3.1 General

All of the following is based on formats as shown in Revision 1 of 451-ICD-NCCDS/MOC. Although nearly many SSA users also use MA, the formats are considered from the perspective of an SSA user who does not currently use MA formats.

- SMA forward service formats are based on MA forward service formats.

- SMA return service formats are based on SSA return service formats.

3.3.2 Database and Scheduling

a. Formats with no new parameters, but with new parameter values for SMA service identification.

   1. Simulation Service Format -- (Table 7-22)

   2. TDRS Unscheduled Time Entry Format -- (Table 7-24)

                        NOTE

         This is applicable to use of WWW interface to obtain TUT information.

   3. Tracking Service Specification Code Data -- (Table A-14)

                        NOTE

         This is applicable to NCCDS database and does not directly affect any user system.

b. Formats with new, or previously unused, parameters for SMAR link identification. Some of these formats also include parameters with new values for SMA service identification.

   1. SSA/SMA Return Service Format -- (Table 7-18)

   2. Normal Tracking Service Format -- (Table 7-20)

   3. Cross-Support Tracking Service Format -- (Table 7-21)

c. New Formats

   1. MA/SMA Forward Service Format -- (Table 7-14)

   2. SMA Forward Service Specification Code Data -- (Table A-2)

                        NOTE

         This is applicable to NCCDS database and does not directly affect any user system.

   3. SMA Return Service Specification Code Data -- (Table A-7)

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    2. Forward Link Sweep Request Message Format -- (Table 8-2)

    3. Expanded User Frequency Uncertainty Request Message Format -- (Table 8-4)

    4. SSA/SMA Return Link Reconfiguration Request Message Format -- (Table 8-9)

    5. Doppler Compensation Inhibit Request Message Format -- (Table 8-11)

b. New Formats

    1. MA/SMA Forward Link Reconfiguration Request Message Format -- (Table 8-5)

3.3.4 Performance Data

a. Formats Applicable to SMA With No Change From SSA

    1. SA/SMAR Service Type Header Data Packet Format -- (Table 8-20)

b. Formats with no new parameters, but with new parameter values for SMA service identification.

    1. SSA/SMA Return Service Data Quality Monitoring Packet Format -- (Table 8-26)

    2. Simulation Forward Service Data Packet Format -- (Table 8-36)

    3. Simulation Return Service Data Packet Format -- (Table 8-37)

c. Formats with new, or previously unused, parameters for SMAR link identification. Some of these formats also include parameters with new values for SMA service identification.

    1. Return Channel Time Delay Measurement Message Format -- (Table 8-16)

    2. Acquisition Failure Notification Message Format -- (Table 8-17)

    3. Time Transfer Message Format -- (Table 8-18)

    4. SSA/SMA DG1 Return Service Data Packet Format -- (Table 8-23)

    5. SSA/SMA DG2 Return Service Data Packet Format -- (Table 8-24)

d. New Formats

    1. MA/SMAF Service Type Header Data Packet Format -- (Table 8-31)

2. MA/SMA Forward Service Data Packet Format -- (Table 8-32)